

**U. S. FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
SACRAMENTO FIELD OFFICE
SACRAMENTO, CALIFORNIA**



***Shaded Riverine Aquatic Cover
of the Sacramento River System:
Classification as Resource Category 1
Under the FWS Mitigation Policy***

OCTOBER 1992

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D-020602



United States Department of the Interior

FISH AND WILDLIFE SERVICE

911 N.E. 11th Avenue
Portland, Oregon 97232-4181

Memorandum

To: Regional Director, U.S. Fish and Wildlife Service
Region 1, Portland, Oregon

From: *Noting* Assistant Regional Director-Fish and Wildlife Enhancement
Region 1, Portland, Oregon

Subject: Mitigation Policy Resource Category 1 Determination Approval

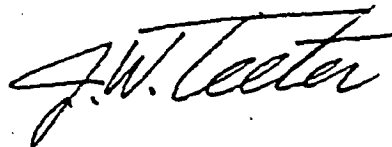
In compliance with the Deputy Director's January 3, 1990, memorandum regarding Fish and Wildlife Service Mitigation Policy and Resource Category Determinations, this is a request for approval of Resource Category 1 Determination for Shaded Riverine Aquatic Cover of selected reaches of the Sacramento River system, Sacramento Valley, California. The justification for the Resource Category 1 Determination is summarized below and detailed in the attached report.

Shaded Riverine Aquatic (SRA) Cover is defined as the nearshore aquatic area occurring at the interface between a river and adjacent woody riparian habitat. The principal attributes of this valuable cover type include: (a) the adjacent bank being composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water, and (b) the water containing variable amounts of woody debris, such as leaves, logs, branches and roots, as well as variable depths, velocities, and currents. These attributes provide high-value feeding areas, burrowing substrates, escape cover, and reproductive cover for numerous regionally important fish and wildlife species, including the State- and federally-listed winter-run chinook salmon and the State-listed bank swallow. However, this cover-type on the Sacramento River and its major tributaries has been rapidly lost over the past 30 years, primarily due to bank protection projects such as the Corps of Engineers' (Corps) Sacramento River Bank Protection Project (SRBPP). Since 1961, the Corps has constructed over 140 miles of riprapped riverbanks in the Sacramento River system. As a result, we estimate that only 7 percent of historic SRA Cover remains in the lower Sacramento River and its four major sloughs.


Past replacement mitigation for the approximate 450,000 linear feet (85 miles) of SRA Cover impacted or destroyed by the SRBPP consists solely of three 300-foot-long experimental dredge berm structures which were constructed in 1991 along the lower Sacramento River and Steamboat Slough in the northern Sacramento-San Joaquin Delta. Although the true habitat value of these structures will not be known for several years, our best biological judgement at this time is that the dredge berms will fall far short of replacing habitat values lost along even the small areas where they were placed.

For the currently-proposed construction contract of the SRBPP, the Service and other involved agencies have worked towards developing effective replacement mitigation for SRA Cover but, due to the unique biological attributes of SRA Cover and institutional constraints on revegetation of riprapped riverbanks, no mutually acceptable solution is available for implementation. Our Habitat Evaluation Procedure analyses show that none of the replacement mitigation methodologies currently allowed by the Corps would replace habitat values lost due to SRBPP construction activities. Thus, we have concluded that, with current bank protection and maintenance strategies, SRA Cover impacted by the SRBPP is irreplaceable.

The Service has determined that categorization of SRA Cover as Resource Category 1 is appropriate. By this action, the Service anticipates that the Corps (action agency) and the State Reclamation Board (local sponsor) will: (1) more actively seek impact avoidance mitigation using setback levees and other approaches, and (2) although SRA Cover is irreplaceable, provide more adequate partial compensation for impacts in instances where impact avoidance measures are truly infeasible due to cost considerations. The Service will revisit this Resource Category I designation should the Corps revise its bank protection practices to incorporate provisions to promote the replacement of SRA Cover in the reaches addressed in this determination.



Approved:



Marvin L. Plenert
Regional Director

Date:

9/24/92

SUBSTANTIATING INFORMATION AND REPORT

REQUEST FOR APPROVAL OF RESOURCE CATEGORY 1 DETERMINATION FOR SHADED RIVERINE AQUATIC COVER OF SELECTED REACHES OF THE SACRAMENTO RIVER SYSTEM, SACRAMENTO VALLEY, CALIFORNIA

September 30, 1992

- I. APPLICABLE FEDERAL PROJECTS: This designation is intended for use primarily with the U.S. Army Corps of Engineers' ongoing Sacramento River Bank Protection Project (SRBPP). This project has to date involved traditional revetment (riprapping) methods whereby natural riverbanks and levees are uniformly reshaped by cutting and/or filling (and complete, or almost complete vegetation removal), then covered with quarry rock to stabilize the riverbanks and halt the natural erosional and depositional processes.

The designation could also apply to any similar projects proposed in the future which may impact this habitat type within the identified areas of concern.
- II. PROJECT SPONSORS: The Reclamation Board of the State of California (Reclamation Board) for the SRBPP, or any other entities which may propose similar projects for the identified areas of concern.
- III. ACTION AGENCIES: The U. S. Army Corps of Engineers (Corps) for the SRBPP, or any other entities which may propose similar projects for the identified areas of concern.
- IV. RESPONSE NEEDED: September 7, 1992.
- V. FIELD CONTACTS: Wayne S. White (Field Supervisor), Richard DeHaven (Branch Chief - Corps of Engineers Projects), Michael Fris and Cindy Levy (Fish and Wildlife Biologists; Corps Projects Branch) FTS: (916) 978-4613
- VI. CHECKLIST INFORMATION:

Name of Habitat: Shaded Riverine Aquatic Cover

Description of Habitat: Shaded Riverine Aquatic (SRA) Cover is the unique, nearshore aquatic area occurring at the interface between a river (or stream) and adjacent woody riparian habitat. Key attributes of this aquatic area include (a) the adjacent bank being composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water, and (b) the water containing variable amounts of woody debris, such as leaves, logs, branches and roots, often substantial detritus, and variable water velocities, depths and flows. Often, much of the instream vegetation consists of dead woody debris that has fallen from the overhanging riparian

vegetation. However, whole trees, which periodically become dislodged from the adjacent eroding banks, often also contribute to the instream structure of SRA Cover.

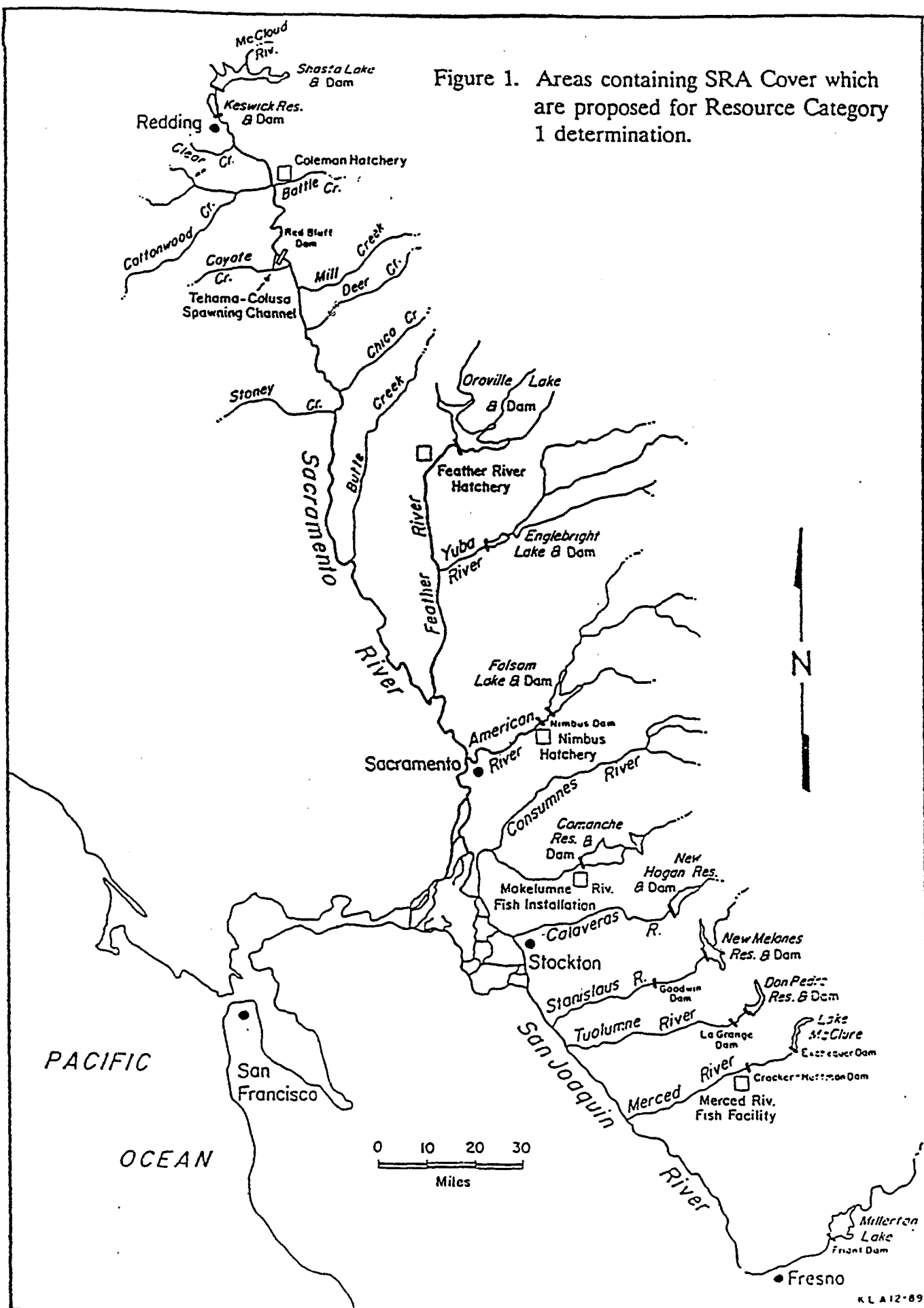
The size of any occurrence of SRA Cover is defined by the length and width of the aquatic area. The length is the distance along the riverbank; the width can be expressed as the average perpendicular distance from the shoreline to the outermost extension of either the vegetative canopy overhanging the water or the living and/or dead vegetation within the water, whichever is greater. Widths can range from as little as 1 or 2 feet to as great as 50 or 60 feet. The relative width is generally a good indicator of overall habitat value; in most cases, the greater the width, the greater is the habitat value.

Areas of Concern: This request pertains to all areas of SRA Cover (as defined above) existing along the following major riverine channels of the Sacramento River system within the Sacramento Valley, California (Figure 1): (1) the Sacramento River, from Keswick Dam (River Mile 302) downstream to Rio Vista (River Mile 13); (2) the Sacramento River's four primary distributary channels--Steamboat, Miner, Sutter, and Georgianna sloughs--which branch off the main river downstream of the city of Sacramento, roughly between the towns of Clarksburg and Walnut Grove; (3) the Feather River, from Oroville Dam downstream to the confluence with the Sacramento River; (4) the Yuba River, from Englebright Dam downstream to the confluence with the Feather River; and (5) the American River, from Nimbus Dam downstream to the confluence with the Sacramento River.

Importance of the Habitat: SRA Cover of these areas is of high value to a wide array of fish and wildlife species. Three of the unique attributes which create such high values are discussed below.

Overhanging vegetation and, in some areas, overhanging banks, provide shade, a form of cover important to the survival of many aquatic organisms, including fish. Overhanging vegetation moderates water temperatures, which is an important factor for all life stages of salmonid fishes. River productivity is increased at all trophic levels by the allochthonous materials and energy input from terrestrial vegetation. The vegetation provides food and habitat for both terrestrial and aquatic invertebrates, which in turn serve as food for numerous bird species and several fish species including chinook salmon and steelhead trout (Hydrozoology 1976; Sekulich and Bjornn 1977). Overhanging vegetation also provides shaded escape cover for fish, and feeding perches for birds such as the belted kingfisher, and nesting and resting areas for birds such as herons, egrets and wood ducks.

The moderating effect of SRA Cover on water temperatures is important to all life stages of anadromous salmonid fishes. Eggs incubating within spawning redds begin experiencing mortality when temperatures exceed about 56° F (Slater 1963; Reiser and Bjornn 1979). Juveniles generally become more susceptible to diseases, parasites, and predation



when temperatures exceed the low-to-mid 60° F range. Adults experience reductions in fecundity and juveniles begin having direct mortality after prolonged exposure to temperatures greater than about the mid-to-upper 60° F range. Direct mortality of adults occurs when temperatures exceed about 70° F for extended periods.

These various water temperature thresholds are already regularly exceeded within the Sacramento River system, including the named reaches. Moreover, recent studies by the Fish and Wildlife Service (USFWS 1990, 1991) and others have clearly demonstrated (by sampling of abundance) the deleterious effect of elevated water temperatures on juvenile salmon outmigration success through the Sacramento River system into the San Francisco Bay. Finally, recent research has provided alarming new evidence that spring-early summer (when most juveniles are emigrating) water temperatures of the Sacramento River may have risen from 2 to 7° F since the late 1970's (Mitchell 1987; Reuter and Mitchell 1987). Increases of this magnitude, which may be due in part to the large, cumulative losses of shade along the river from bank protection activities, could be highly detrimental to already declining salmonid stocks. The shade component of SRA Cover is thus clearly of high potential importance to anadromous salmonids.

In-water cover, in the form of (a) woody vegetation from overhanging or fallen trees or branches, (b) aquatic vegetation, (c) variable substrate types and sizes, and (d) generally irregular banks, provides habitat necessary for a wide range of regionally important fish and wildlife species. Orientation and size of woody debris enhances channel and habitat heterogeneity by altering flow direction and velocity (Everest and Meehan 1981). The diversity of microhabitats present allows for high species diversity and abundance (Angermeier and Karr 1984; Bisson et al. 1987; Sedell and Swanson 1984). Vegetative debris also provides a food source for instream invertebrates, which in turn are eaten by several fish species. Aquatic stream invertebrate productivity is usually highest in nearshore areas at depths between 0.15 and 0.9 meters (Hooper 1973). Thus, a broad food base and extensive cover and habitat niches are supported by in-water cover. These values in turn create high fish and wildlife diversity and abundance at all trophic levels.

Ripraping of the stream banks reduces the physical complexity of the river channel and removes the numerous debris dams and slack flow areas where allochthonous organic matter accumulates and anerobic conditions develop. Dahm, Trotter and Sedell (1987) and others have shown that in these natural bank areas the concentrations of several important organic and inorganic nutrients are much greater than where channelization has occurred; thus, overall channel productivity may be enhanced by the greater nutrient availability in the natural areas.

Removal of instream structures can also cause disorientation of fishes, and disrupt their territorial behaviors which are often associated with feeding and reproduction. Nearshore vegetation also provides spawning

substrate for several fish species. Several birds (e.g., herons, egrets, and belted kingfisher) and mammals (e.g., beaver, mink and river otter) utilize these productive nearshore areas for feeding, resting areas and cover (Melquist and Hornocker 1983; CDFG 1990). Hehnke and Stone (1978) found that bird species diversity on riprapped banks of the Sacramento River was 71 percent lower than on natural banks. Muskrats rely upon emergent nearshore vegetation as a food source, whereas many other vertebrate species feed on fishes and invertebrates which are concentrated within SRA Cover areas. The western pond turtle basks on partially submersed logs on riverbanks (Stebbins 1985). Bullfrog survival has been shown to become reduced where vegetative cover and woody debris are lacking (Brown 1972); they often hibernate in submerged nearshore muddy, debris-covered substrates (Willis et al. 1956). Several other herpetofauna also use woody debris and leaf litter which washes up on river shorelines as cover (Jones 1988; Jones and Glinski 1985); thus SRA Cover can be beneficial to a wide range of species not immediately dependant on the aquatic portion of the riparian community.

Natural, often eroding banks, composed of soil, sand, gravel, silt, or clay often have cavities, depressions and vertical faces which provide substrate required by certain bank-dwelling birds (e.g., bank swallows, rough-winged swallows, and belted kingfisher), mammals (e.g., muskrat, mink, beaver, and river otter) and fish (e.g., channel catfish) for feeding, cover, and shelter. Many species utilize these areas as access and egress points from shore to water, or as nesting or burrowing areas (CDFG 1992). Natural erosion of natural bank substrates also provides instream spawning substrate for numerous aquatic species, including anadromous salmonids.

In combination, the three key attributes of SRA Cover discussed above (overhanging vegetation, in-water cover, and natural banks) contribute to making this cover type a very unique, highly productive land-water interface zone which is critically important to a wide range of both terrestrial and aquatic species of high regional importance. SRA Cover increases overall stream productivity by providing allochthonous energy and materials. These materials are used by numerous aquatic organisms which, in turn, are used by numerous other aquatic and water-feeding terrestrial and avian species. Moreover, areas of SRA Cover contribute energy and materials to other downstream habitats throughout the Sacramento River system, including the Sacramento-San Joaquin Delta and San Francisco Bay. Although not presently quantified, the continued removal of this habitat type could have far-reaching, possibly irreversible, impacts.

Uniqueness of the Habitat: As discussed in the above section, SRA Cover along the Sacramento River can be considered unique because of its special attributes which create high values to numerous fish and wildlife species that inhabit terrestrial and aquatic areas of the Sacramento River system. No other cover type along the river supports such diverse and abundant fauna. The richness and abundance of the

fauna of SRA Cover is particularly apparent when compared to neighboring, riprapped riverbanks.

One of the most important features demonstrating the uniqueness of SRA Cover is its degree of utilization by anadromous salmonid fishes, including the State- and federally-listed winter-run chinook salmon (*Oncorhynchus tshawytscha*) and the State-listed bank swallow (*Riparia riparia*). Because of the importance of SRA Cover to the winter-run salmon, the National Marine Fisheries Service and the California Department of Fish and Game stated in their 1991 Biological Opinions (CDFG 1991; NMFS 1991) relative to impacts of the SRBPP, that approved, detailed mitigation plans which adequately compensate for impacts are required prior to contract construction. Similar mitigation plans are required for the bank swallow (CDFG 1991) before natural, eroding banks that contain bank swallow colonies, many of which are contained within areas of SRA Cover, can be removed during SRBPP construction. The Service views the need for full, in-kind replacement of habitat values of SRA Cover as critical for the continued benefit and possibly the survival of the bank swallow, and winter-run chinook salmon and other salmonid races.

The channels discussed in this report are used annually by millions of juvenile salmonids. After smoltification, these fish enter the Pacific Ocean and provide important commercial and recreational fisheries with a net economic value of over \$50 million annually. Surviving adult salmonids, of which populations have decreased dramatically from average annual numbers in the recent past of about 275,000 salmon and 50,000 steelhead, then return to spawn in the upstream reaches of the named channels. During their upstream migrations to spawning areas, these adult salmonids provide a significant freshwater sport fishery. The salmon spawner escapement from the channels named in this request still amounts to more than half the present total spawning escapement for all of California's rivers and streams. However, populations of anadromous salmonids in the Sacramento River system are displaying dramatic declining trends due to drought, habitat degradation and other factors. For example, winter-run chinook salmon escapement declined from over 100,000 fish in the 1960's to an all-time low of 191 fish in 1991; spring-run chinook escapement declined to a low of 771 fish during the same year. Steelhead counts at the Red Bluff Diversion Dam on the Sacramento River have also declined, from 17,416 in 1968 to 2,322 in 1990.

SRA Cover of the channels named in this request is important to various life stages of salmonids, but is probably most important to juveniles. It provides them with abundant food resources, protection from predators, and an abundance of nearshore water conditions for their various growth stages and needs. The value of SRA Cover has been demonstrated by various studies which have compared juvenile salmon abundance along riprapped banks as compared to natural banks along the Sacramento River. For example, a Department of Fish and Game (CDFG 1983) study between Red Bluff (River Mile 244) and Ord Bend (River Mile 184) found about two-thirds fewer juvenile chinook salmon along

riprapped than along natural, eroding riverbanks. From 1984 through 1988, annual surveys by the Service (Michny and Hampton 1984; Michny and Diebel 1986; Michny 1987, 1988, 1989) of the Sacramento River between roughly Chico Landing (River Mile 193) and Red Bluff found only about 10-20 percent as many juvenile salmon along riprap as along natural riverbanks, and the highest densities of juveniles always occurred in areas with characteristics of SRA Cover. A similar, preliminary survey by the Service in 1988 along the lower Sacramento River (downstream of Sacramento) and distributaries failed to detect such population differences during spring when low-to-moderate water temperatures prevailed. However, during early summer when the Sacramento River warmed to over 70° F, juvenile salmonids were found exclusively in SRA Cover; none were captured in nearby riprapped areas (DeHaven 1989b).

Although the bank swallow does not exclusively require SRA Cover areas, the majority of suitable nesting sites for these birds are located in areas that include SRA Cover. The bank swallow nests in colonies in eroding banks, usually composed of sandy-type soils. Colonies are found on the Sacramento River, mainly upstream of Sacramento, and on the Feather and Yuba rivers. Existing SRA Cover sites which are presently unsuitable for nesting may be suitable sites in future years, as bank erosion continues. Thus, the current riprapping practices on areas with SRA Cover eliminate future nesting areas for this threatened species.

Status of the Habitat: Several reports discussing the location, value, scarcity and irreplaceability of SRA Cover have been prepared by the Service (DeHaven and Taylor 1988; DeHaven and Weinrich 1988a; DeHaven and Weinrich 1988b; DeHaven 1989a, 1989b; CDFG 1992). These reports conclude that SRA Cover is becoming increasingly scarce throughout the Sacramento River system.

During about 100 years from 1870 to 1970, the Sacramento Valley lost over 98 percent of its riparian vegetation. Since SRA Cover is closely associated with riparian vegetation, it is reasonable to speculate that a similar reduction of this valuable cover type has also occurred over the same time span.

In 1988, the Service inventoried the SRA Cover remaining along the lower Sacramento River and its four primary distributaries (DeHaven and Weinrich 1988a). Of 167 miles of riverbanks (83.5 miles of channels), only 33 miles (20 percent) had any SRA Cover. Moreover, on this 33 miles, SRA Cover remaining was generally relatively narrow (less than 10 feet) in width, primarily due to extensive efforts by State and Federal agencies and local reclamation districts to keep the levees relatively clear of vegetation. Riprapped riverbanks, which are also kept clear of vegetation, probably exacerbate the situation because these areas do not add woody instream cover to the river system. As a result, the total area of remaining habitat was extremely small--only about 28 acres--and considerably less than optimum in habitat values.

In contrast, under more pristine conditions, the same area probably had well over 400 acres of SRA Cover (assuming an average width of 25 feet along 80 percent of the riverbanks) with optimum or near-optimum habitat values. Thus, these river reaches have sustained at least a 93 percent additional loss of habitat area, and probably an even greater loss in habitat quality over just the past few decades.

The 1988 Service inventory also provided estimates of the recent losses of SRA Cover that occurred during the 15-year period from 1972 through 1987 for this same area. The total loss of SRA Cover during this period was about 7.9 acres and 11.6 miles of that remaining (22 and 26 percent, respectively). At least 88 percent of these losses were estimated to be the result of bank protection efforts, including riprapping by the SRBPP. Similar evaluations by the Service of the upper Sacramento River show similar results. For example, we estimate, based on our habitat mapping (Keck 1990; Storfer 1992) that about 450,000 linear feet of SRA Cover has been removed from the Sacramento River and Sacramento-San Joaquin Delta as a result of bank protection and revetment efforts.

Another problem is that the small amount of SRA Cover remaining is not uniformly distributed along the river channels. The distribution tends to be highly clumped, with many channel reaches of from 1 to 5 miles in length being completely riprapped and thus completely devoid of any woody riparian vegetation or SRA Cover. In one instance, about a 10-mile-long reach of the lower Sacramento River is presently devoid of this valuable cover type. If present trends continue, many such areas will soon exist along the entire river. According to Forman (1983), fragmentation of habitat such as the riparian forest-SRA Cover corridor is the critical factor influencing its habitat value. The end result of such fragmentation is likely to be: (1) a loss of wide-ranging species (e.g., winter-run salmon); (2) reduced population viabilities and genetic integrity; and (3) enhanced habitat quality for generalist species characteristic of disturbed environments. The final result, unless the processes are halted, is that SRA Cover will likely lose its basic unique, distinguishing biological characteristics and acquire mainly the common generalist species (Harris 1988; Sampson and Knopf 1982).

Replaceability of the Habitat: The present bank stabilization practices and riprapping of the SRBPP destroy most, if not all, of the unique values of any SRA Cover. During bank protection, the naturally occurring, irregularly-shaped riverbanks are uniformly straightened and covered with a relatively uniform, smooth layer of quarry rock. Erosion is thus completely halted. Substrate diversity is greatly reduced. All vegetation overhanging and within the water is removed. Most vegetation along the bank and upper levee slope is also removed. Nearshore aquatic areas are generally deepened and re-sloped with a uniform gradient away from the shoreline. The variability of water depths, velocities, and directions in nearshore areas is thus replaced with a relatively uniform water flow of moderate-to-high velocity along the riprap. Moreover, maintenance efforts are generally intensified

following riprapping to keep the reformed levee clear of any riparian vegetation regrowth.

For reasons which are both institutional and biological, SRA Cover is not fully replaceable along the same channels where bank protection is instituted. The application of rock revetment inhibits vegetation from growing on levees and bank slopes, thus eliminating the wildlife benefits that stem from overhead cover, and reducing the amount of woody vegetation that falls into the aquatic system. Further exacerbating the problem is the levee districts' practice of maintaining the revetted banks clear of vegetation, in accordance with guidelines established by the Corps of Engineers and State Reclamation Board. The banks are maintained because it is believed that vegetation may threaten the stability of the revetted bank and prohibit accurate inspections of levee integrity. This occurs despite recent studies (Shields *et al.* 1990; Shields 1991), indicating that in most areas bank stability may actually be increased by vegetation. Thus, the allowance of woody vegetation on riprapped streambanks merits further examination. Although we have repeatedly petitioned the Corps of Engineers to modify the revetment maintenance guidelines so as to allow more woody vegetation along riprapped shorelines, no action has been taken and we do not anticipate significant changes in bank maintenance practices any time in the near future.

Even if revetment maintenance guidelines were changed, the river system where riprapped banks occur would not support SRA Cover with the same high habitat values as existing natural banks. Burrowing areas for most species, including the bank swallow, would be eliminated. The halting of natural erosional processes would result in a loss of instream woody vegetation, because large trees would no longer enter the aquatic system. Contributions of other allochthonous materials and energy sources would be similarly decreased, thus lowering overall productivity within the riverine ecosystem.

Mitigation: Despite the high value of this cover type to fish and wildlife, little meaningful mitigation for SRA Cover has been provided for SRBPP construction. The primary replacement mitigation in use by the construction agencies involves the replanting of riparian vegetation on levee berms (a relatively flat, bench-like area which occurs above the mean water surface along some levees). However, with this method, riparian vegetation is not replanted or allowed to regrow naturally to any significant degree (due to levee maintenance considerations) along the levee slopes, either above or below the berm. Thus, the critical land/water interface necessary for development of SRA Cover is not replaced. At best, when the vegetation on the berm matures, the only attribute of SRA Cover likely to be replaced is a relatively small area of shade along the nearshore aquatic area. Other key components of SRA Cover, such as natural, irregular banks, vertical areas, root wads, crevices, and in-water vegetation, which greatly expand the diversity of this cover type, are not replaced. Furthermore, most of these attributes will not reappear at the site over time. Figure 2 provides cross-sectional views of typical SRA

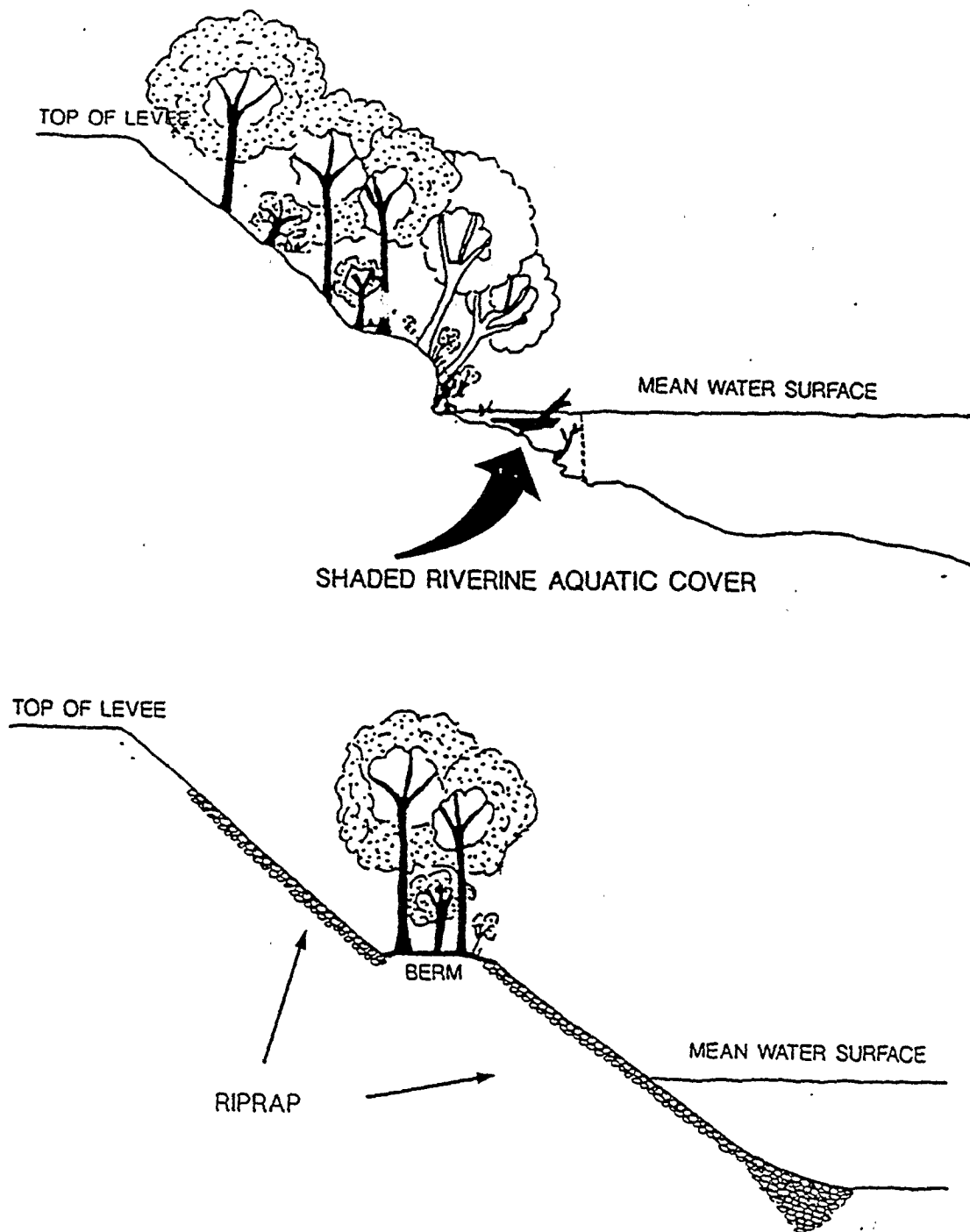


Figure 2. Top view: Typical area of SRA Cover. Bottom view: Typical riprapping with berm replanting for mitigation.

Cover and berm replanting areas, further illustrating the lack of on-site replaceability using the berm replanting technique.

In 1991, three experimental dredge berms, each about 300 feet in length, were constructed along the lower Sacramento River and Steamboat Slough in the northern Sacramento-San Joaquin Delta. To date, these remain as the only replacement mitigation for the SRBPP. These berms, each of a different design, consist of a levee berm, created with dredge material placed atop existing riprap and planted with riparian vegetation, and instream structures (brush packs, concrete panels, logs and automobile tires were used at different sites). Basically, the dredge berms involve attempts at recreating the natural bank and SRA Cover characteristics over the top of existing riprapped banks. Studies have been initiated to determine their effectiveness in providing mitigation for lost SRA habitat values, but the true value of these measures will not be known for several years. Our best biological judgement at this time is that the dredge berms will be only partially effective as replacement mitigation for SRA Cover. In addition, the construction agencies have maintained that the dredge berm concept is generally unacceptably expensive and cannot be widely applied throughout the Sacramento River system because of channel width constraints. The future viability of this replacement mitigation approach is thus highly questionable.

To date, the only effective means of mitigation for SRA Cover losses has been avoidance, by deleting or shortening the length of construction sites. Avoidance could also be accomplished through the reconstruction of levees set back from the river. This alternative has never been seriously considered by the Corps because of the potential expenses involved in purchasing lands and relocating other facilities near the river. To our knowledge the Corps has never released a detailed feasibility study on the costs of set-back levees on any part of the Sacramento River, as compared to what undoubtedly will be very high costs to provide full, in-kind replacement mitigation if the impacts to SRA Cover and related habitats continue to occur.

Other, more environmentally sensitive alternatives to bank protection also remain unconsidered. Natural levee protection alternatives, such as the planting of flood-resistant plants (e.g., willows), have received little attention. In addition, biotechnical slope stabilization techniques and alternate bank protection materials, which allow for the reestablishment of woody riparian species, remain uninvestigated for this project. These methods have not been approved by the Corps or State Reclamation Board, and thus have been shelved until an undetermined later date.

Over the past year, staff of all involved resource and construction agencies have been unsuccessful in working towards mutual agreement on appropriate replacement mitigation. The great difficulty in providing replacement mitigation is mainly a function of the characteristics of this unique habitat, which seemingly are in direct opposition to current standards for bank protection and bank maintenance practices.

River bank revetment, vegetation removal, clearing of woody debris, and even the arresting of bank erosion all remove essential habitat values of SRA Cover from the sites. We view the functional characteristics (woody cover, naturally-eroding banks) of SRA Cover as being natural to a fully functioning stream ecosystem, whereas current bank protection practices are designed to eliminate that naturalness.

Habitat Evaluation Methods: Recently, the Service has used the Habitat Evaluation Procedures (HEP) to determine the impacts to SRA Cover due to proposed SRBPP Contract 42A, and to assess potential mitigation measures for future project impacts. We used a modified model, in which the cover type (in this case, SRA Cover) is described directly and used to determine Habitat Suitability Indices (HSI's). This provided us with a simpler, more direct assessment of habitat quality than the use of one or more species-based HSI models.

Our analyses have focussed on three basic functional components of SRA Cover to determine the values of undisturbed SRA Cover and alternative mitigation measures; the three components were instream cover, overhead cover and water depth. A qualitative description of how these components are used in the model follows.

Instream cover refers to the amount of instream structure that occurs at the SRA Cover site. Logs, branches and large, irregular substrate masses provide a variety of microhabitats for aquatic organisms, and break up part of the smooth, high-velocity flows associated with standard revetment. For mitigation measures, the highest values were given to replacement features which provided a high proportion of woody cover, indentations and projections on the banks, and would be likely to remain in place over the life of the project. Thus, many of the replacement mitigation alternatives would require periodic restocking of woody instream cover.

Overhead cover (over-water canopy density) refers to the amount of vegetation actually hanging over the water's edge, thus providing shade, woody vegetation, detritus and insect drop to the river. Highest replacement values were given to replantings on berms located close to the riverbank.

Water depth refers to the mean depth of the river 5 feet away from the bank. Generally, fish and wildlife values are highest where nearshore areas range between 1 and 3 feet deep. Also, areas with variable depths are better than those with uniform depth. Bank protection work usually entails removing such diversity and creating uniformly deep nearshore areas along the riprapped bank; thus habitat values are lowered. In our model, shallow water areas received the highest values.

Several mitigation features, including many of those discussed in a recent interagency brainstorming session, were evaluated using the SRA Cover model comprising these three basic habitat components. The features included low berms, riparian replanting, tethered trees, fish

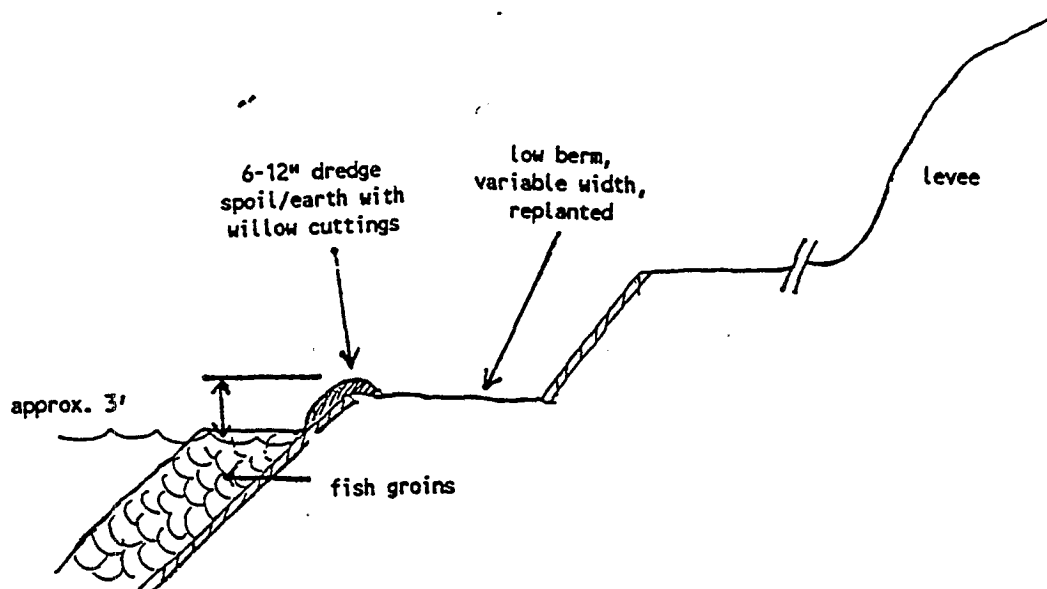
groins, gravel-covered riprap, dredge-spoil covered riprap, and various combinations of these measures. The analysis showed that none of these measures, on their own, can provide on-site, in-kind mitigation for project impacts. The only mitigation measure that would theoretically provide a nearly-suitable degree of replacement mitigation was a combination of the following: low berms, rock groins spaced 50 feet apart, dredge spoil between the groins, and trees planted in the dredge spoil and on low berms. (These measures would be placed on top of the revetted banks.) From the variety of components needed to accomplish this theoretical mitigation approach, we dubbed it "The Works". Figure 3 depicts The Works graphically.

In terms of the most critical (i.e., fishery) habitat values, as assessed by our three-component HSI model, The Works could theoretically provide nearly full, in-kind mitigation with one linear foot of bank protection being replaced by about one linear foot of The Works (i.e., 1:1 replacement ratio, linearly). Hence, this measure could be a solid starting point towards meeting the requirements of a mitigation plan without purchase of additional lands for mitigation. The same sites that are impacted could be restored.

Unfortunately, for several reasons, The Works would not be feasibly implementable for SRBPP projects. First, this measure as it stands now does not conform to the Corps' and the Reclamation Board's current standards for levee construction, maintenance and liability. As a result, to date, these SRBPP construction agencies have offered only to implement portions of The Works scenario at selected proposed construction sites. This would be totally unacceptable, because replacing the habitat values of SRA Cover in-kind necessitates that all components of the habitat be replaced simultaneously and at the same site. Costs of The Works measure are also quite high. Furthermore, in some cases, creation of berms along the banks may require more substantial impacts to already-existing riparian vegetation which, on the Sacramento River, provides habitat for several State- and federally-listed species. Moreover, in a biological sense, The Works could not replace habitat values for all species which use naturally-existing SRA Cover. Species dependant on earthen, soft banks for burrowing, nesting, or feeding would not utilize this mitigation alternative. Finally, for winter-run salmon, The Works would not provide sufficient habitat value for at least fifteen to twenty years from the time of construction, because woody instream-vegetative cover would not be provided by streamside replantings until they grow to an adequate size. Any replacement mitigation measures would need to provide sufficient habitat values directly after construction, due to the present risk of extinction of winter-run salmon.

The Service and the California Department of Fish and Game have also considered options for replacing habitat values of SRA Cover by replanting riparian vegetation along the waterline of existing, unvegetated natural banks, either on the river channels named here (Option 1), or on other riverine or palustrine shoreline reaches (Option 2). Option 1 is not feasible, because most of the few

Sectional View



Aerial View

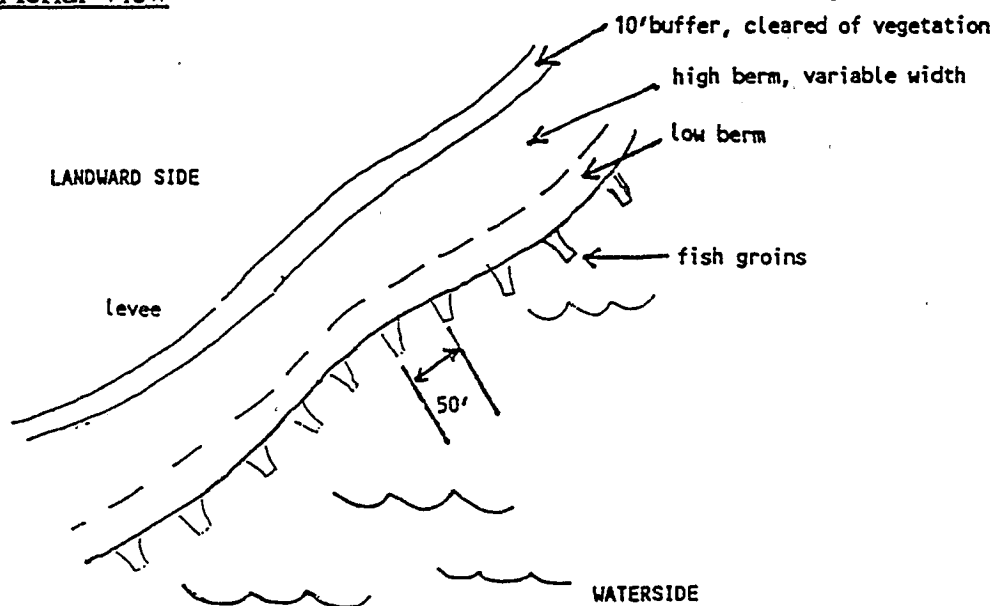


Figure 3. "The Works", a proposed SRA Cover replacement mitigation design for Contract 42A of the Sacramento River Bank Protection Project.

remaining miles of natural, unriprapped banks of the Sacramento River system already have SRA Cover. Only minimal, if any, improvement of this cover is possible. Option 2 is feasible, but of low value, because potential improvement sites are quite small, widely scattered, and are primarily located along areas where anadromous salmonids do not occur. Such off-site replacement would thus not be biologically acceptable. The Service and the Department of Fish and Game firmly believe that losses of salmonid habitat within the Sacramento River system should be replaced in-kind and in the same system.

In the future, research may provide other construction and maintenance techniques for fully replacing the habitat values of SRA Cover. To date, however, impact avoidance measures such as set-back levees remain the only environmentally sound alternative.

- VII. THE PRESENT SITUATION: Since 1960, Congress has authorized a total of 158 miles of bank protection under the first two phases of the SRBPP. About 140 miles of this work have been completed and about 20 more miles are scheduled for completion within the next few years. The Corps of Engineers is currently seeking authorization for a third phase, which would result in about 40-50 miles of additional bank protection in the Sacramento River system; at present, avoidance measures such as set-back levees are not a part of project planning, design, and authorizations. Before 1990, from one to three construction contracts were issued each year. Each contract generally comprised 10 to 25 individual sites totalling at least several miles in length. However, no contracts have been constructed since 1989 because of constraints imposed on the action agencies due to issues revolving around the numerous State- and federally-listed species which are present in the SRA Cover and associated riparian forests of the Sacramento River system.

Each new contract that is completed would permanently remove a substantial part of the river's remaining SRA Cover. In the past, only token replacement mitigation has been attempted. For the currently proposed Contract 42A, replacement efforts proposed by the Corps consist mainly of rock groins, an instream fishery mitigation structure which, according to our analyses, would be of little value in replacing the full range of lost SRA Cover habitat values. A few berm structures, which would allow revegetation near the water, are also proposed, but they would also be of little value for achieving the desired full, in-kind replacement of habitat values needed as replacement for SRA Cover.

- VIII. WHAT THE SERVICE SEEKS TO ACHIEVE: We believe that, from a biological standpoint, a Resource Category 1 determination is fully justified. One of our goals in establishing this Resource Category 1 classification for SRA Cover is to prompt the Corps of Engineers and Reclamation Board to provide more impact avoidance mitigation during implementation of the SRBPP. Avoidance mitigation may take several forms. First, there are some entire bank protection sites that could be shortened, deleted or substantially delayed, because erosion of the

bank has not been quantitatively shown to pose a significant threat to levee integrity. Avoidance of impacts may also be achieved by a greater reliance on erosion-specific levee repairs; the present practice of the Corps is to riprap relatively long, contiguous reaches of riverbank, although the erosion is frequently confined to just a few, relatively small "pockets". However, the Service's most preferred form of impact avoidance is through the construction of set-back levees. Set-back levees may take one of three basic forms: 1) small-to-moderate extensions of the landward side of the existing levee; 2) larger extensions of the landward side of the existing levee, such that the old levee can be formed into a berm area; and 3) entirely new levees, set some distance back from the existing levee. Set-back levees would not only avoid most impacts to SRA Cover and riparian forests along the Sacramento River system, but would, in some instances allow the river to meander somewhat naturally. Such natural meandering would allow some rejuvenation of SRA Cover and related cover-types. Set-back levees are expensive, however, and to minimize costs would likely need to be confined to reaches where infrastructure (roads, powerlines, buildings, pumps, water conveyance facilities, etc.) is minimal.

Our secondary goal with respect to SRA Cover is to prompt the construction agencies to provide more adequate replacement mitigation (although SRA Cover is irreplaceable, a much better job of *partial* replacement could be done) for bank protection sites where avoidance of impacts is truly infeasible. The replacement mitigation implemented to date provides only a minute fraction of the total habitat values of the SRA Cover which has been removed by the SRBPP, and this trend is continuing. For example, the Corps' currently proposed replacement mitigation for Contract 42A is woefully inadequate, partly because they have ignored many of the Service's recommendations which would have achieved the maximum possible partial replacement value.

- IX. PROPOSED MITIGATION PLANNING GOAL: Our primary planning goal will be to achieve no loss of existing habitat value, acreage and riverside length. However, as provided for in the Mitigation Policy, applicable non-biological factors such as costs will also be considered. Also, consideration will be given to the fact that each occurrence of SRA Cover has a somewhat different degree of high values for fish and wildlife. The highest SRA Cover values will generally occur at the widest occurrences and at the areas where this habitat is now scarcest. Thus, each bank protection site will have to be considered individually in developing the Service's specific mitigation recommendations. SRA Cover will always be Resource Category 1, but the Service's mitigation planning recommendations will vary according to circumstances. For any given contract of the SRBPP, the Service will be recommending combinations of various impact-avoidance measures and replacement methods to achieve the primary mitigation planning goal, but our emphasis will definitely be more strongly and profoundly in favor of avoidance techniques.

X. REFERENCES:

- Angermeier, P.L., and J. R. Karr. 1984. Relationships between woody debris and fish habitat in a small warm water stream. Transactions of the American Fisheries Society 113:716-726.
- Bisson, P.A., R.E. Bilby, M.D. Bryant, D.A. Dolloff, G.B. Grette, R.A. House, M.L. Murphy, K.V. Doski and J.R. Sedell. 1987. Large woody debris in forested streams in the Pacific northwest: past, present and future. Pages 143-190 in E.O. Salo and T.W. Cundy, editors. Streamside management: forestry and fishery interactions. University of Washington, Seattle, Washington. Contribution No. 57.
- Brown, R.E. 1972. Size variation and food habits of larval bullfrogs, *Rana catesbeiana* (Shaw), in western Oregon. Ph.D. Thesis, Oregon State University, Corvallis, Oregon. 83 pp.
- California Department of Fish and Game. 1983. Sacramento River and tributaries bank protection and erosion control investigation -- evaluation of inputs on fisheries.
- California Department of Fish and Game. 1990. California's Wildlife. Volume III: Mammals. California wildlife habitat relationships system. California Department of Fish and Game, Sacramento, California. 407 pp.
- California Department of Fish and Game. 1991. CESA Biological Opinion, Sacramento River Bank Protection Project, Second Phase, Contract 42A. CESA No. 9002. November 18, 1992. 11 pp.
- California Department of Fish and Game. 1992. Letter, dated May 6, 1992, from James Messersmith to John Winther, President, Delta Wetlands. CDFG Region 2. Rancho Cordova. 4 pp.
- Dahm, C.N., E.H. Trotter and J. R. Sedell. 1987. Role of anaerobic zones and processes in stream ecosystem productivity. Pages 157-178 In: R.C. Averett and D.M. McKnight, editors. Chemical quality of water and the hydrologic cycle. Lewis Publishers, Inc. Chelsea, Michigan.
- DeHaven, R.W. and G.L. Taylor. 1988. Inventory of heavily-shaded riverine aquatic cover for the lower Sacramento River and Sacramento-San Joaquin Delta. Part III: Sacramento River, American River to Natomas Cross Canal. USFWS Report, Sacramento Field Office. October 1988. 10 pp.
- DeHaven, R.W. and D.C. Weinrich. 1988a. Inventory of heavily-shaded riverine aquatic cover for the lower Sacramento River and Sacramento-San Joaquin Delta. Part I: Lower Sacramento River and Distributaries. USFWS Report, Sacramento Field Office. March 1988. 23 pp.

- DeHaven, R.W. and D.C. Weinrich. 1988b. Inventory of heavily-shaded riverine aquatic cover for the lower Sacramento River and Sacramento-San Joaquin Delta. Part II: Selected Delta islands. USFWS Report, Sacramento Field Office. April 1988. 31 pp.
- DeHaven, R.W. 1989a. Value, scarcity, uniqueness and replaceability of shaded riverine aquatic cover of selected reaches of the Sacramento River system, Sacramento Valley, California. USFWS Report, Sacramento Field Office. March 1989. 11 pp.
- DeHaven, R. W. 1989b. Distribution, extent, replaceability and relative values to fish and wildlife of shaded riverine aquatic cover of the lower Sacramento River, California. USFWS Report, Sacramento Field Office. April 1989. 43 pp and appendices.
- Everest, F.H., and W.R. Meehan. 1981. Forest management and anadromous fish habitat productivity. Transactions of the North American Wildlife and Natural Resources Conference 46:521-530.
- Forman, R.T.T. 1983. Corridors in a landscape: Their ecological structure and function. *Ekologia (CSSR)* 2:375-387.
- Harris, L.D. 1988. The nature of cumulative impacts on biotic diversity of wetland vertebrates. *Environmental Management* 12:675-693.
- Hehnke, M. and C.P. Stone. 1978. Value of riparian vegetation to avian populations along the Sacramento River system. In: R.R. Johnson and J.F. McCormick, editors. Strategies for protection and management of floodplains, wetlands, and other riparian ecosystems. U.S. Department of Agriculture. Forest Service General Technical Report WO-12. Forest Service, Washington, D.C.
- Hooper, D.R. 1973. Evaluation of the effects of flows on trout stream ecology. Department of Engineering Research, Pacific Gas and Electric Company, Emeryville, California. 97 pp.
- Hydrozoology. 1976. Food habits of juvenile king salmon in the Sacramento-San Joaquin Delta, 1975-1976. Prepared for the U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento, California. 29 pp.
- Jones, K.B. 1988. Comparison of herpetofaunas of a natural and altered riparian ecosystem. Pages 222-227 in R.C. Szaro, K.E. Severson and D.R. Patton, technical coordinators. Management of amphibians, reptiles, and small mammals in North America. U.S. Department of Agriculture, Forest Service General Technical Report RM-166. Rocky Mountain Forest and Range Experimental Station, Fort Collins, Colorado.

- Jones, K.B., and P.C. Glinski. 1985. Microhabitats of lizards in a southwestern riparian community. Pages 342-346 in Riparian ecosystems and their management: reconciling conflicting uses. U.S. Department of Agriculture, Forest Service General Technical Report RM-120. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
- Keck, R.A. 1990. Baseline habitat inventory and mapping for Sacramento River Bank Protection Project, Third Phase. U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, California. 16 pp.
- Melquist, W.E., and G. Hornocker. 1983. Ecology of river otters in west central Idaho. Wildlife Monographs 83. 60 pp.
- Michny, F. and M. Hampton. 1984. Sacramento River Chico Landing to Red Bluff Project 1984 juvenile salmonid study. Prepared for Corps of Engineers, Sacramento District by Fish and Wildlife Service, Sacramento. 24 pp.
- Michny, F. and R. Deibel. 1986. Sacramento River Chico Landing to Red Bluff Project 1985 juvenile salmon study. Prepared for Corps of Engineers, Sacramento District by Fish and Wildlife Service, Sacramento. 22pp.
- Michny, F. 1987. Sacramento River Chico Landing to Red Bluff Project 1986 juvenile salmon study. Prepared for Corps of Engineers, Sacramento District by Fish and Wildlife Service, Sacramento. 8 pp. and Appendix.
- Michny, F. 1988. Sacramento River Butte Basin reach preproject juvenile salmon study. Prepared for Corps of Engineers, Sacramento District by Fish and Wildlife Service, Sacramento. 8 pp.
- Michny, F. 1989. Sacramento River Chico Landing to Red Bluff Project 1987 juvenile salmon study. Draft Report prepared January 1989 for Corps of Engineers, Sacramento District by Fish and Wildlife Service, Sacramento.
- Mitchell, W.T. 1987. Evaluation of the frequency and duration of exposure of downstream migrant chinook salmon to high water temperatures in the Sacramento River. Prepared for California Department of Water Resources by D. W. Kelley and Associates, Newcastle, California. 9 pp.
- National Marine Fisheries Service. 1991. Endangered Species Act Section 7 Consultation, Biological Opinion. October 28, 1991. 7 pp.

- Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. Pages 1-45 in Influence of forest and rangeland management on anadromous fish habitat in the western United States and Canada. W.R. Meehan, technical editor. USDA Forest Service General Technical report PNW-96.
- Reuter, J. E., and W. T. Mitchell. 1987. Spring water temperatures of the Sacramento River. Prepared for California Department of Water Resources by D. W. Kelley and Associates, Newcastle, California. 65 pp and appendices.
- Sampson, F.B., and F.L. Knopf. 1982. In search of a diversity ethic for wildlife management. Transactions of the North American Wildlife and Natural Resources Conference 47:421-431.
- Sedell, J.R., and F.J. Swanson. 1984. Ecological characteristics of streams in old-growth forests of the Pacific Northwest. Pages 9-16 in W.R. Meehan, T.R. Merrill, Jr., and T.A. Hanley, editors. fish and wildlife relationships in old-growth forests: Proceedings of a symposium held in Juneau, Alaska 12-15 April 1982. American Institute of Fisheries Research Biology.
- Sekulich, P.T., and T.C. Bjornn. 1977. The carrying capacity of streams for rearing salmonids as affected by components of the habitat. Completion Report for Supplement 99, USDA Forest Service. 79 pp.
- Shields, F.D., Jr. 1991. Woody vegetation and riprap stability along the Sacramento River mile 84.5-119. Water Resources Bulletin 27:527-536.
- Shields, F.D., Jr., L.T. Ethridge and T.N. Waller. 1990. A study of vegetation on revetments, Sacramento River Bank Protection Project, Phase 1: literature review and pilot study. Technical Report HL-90-19, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. 109 pp. + appendices.
- Slater, D.W. 1963. Winter-run chinook salmon in the Sacramento River, California, with notes on water temperature requirements at spawning. U.S. Department of the Interior, U.S. Fish and Wildlife Service Special Scientific Report-Fisheries No. 461. 9 pp.
- Stebbins, R.C. 1985. A field guide to western reptiles and amphibians. Peterson Field Guide Series, Volume 16. Houghton-Mifflin Company, Boston, Massachusetts. 336 pp.
- Storfer, A. 1992. Baseline habitat inventory and mapping for Sacramento River Bank Protection Project, Third Phase. U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, California. 20 pp.

- U. S. Fish and Wildlife Service. 1990. Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin estuary. 1990 annual progress report. FWS Sacramento-San Joaquin Fishery Resource Office, Stockton, California. 133 pp.
- U. S. Fish and Wildlife Service. 1992. Abundance and survival of juvenile chinook salmon in the Sacramento-San Joaquin estuary. 1991 annual progress report. FWS Sacramento-San Joaquin Fishery Resource Office, Stockton, California. 100 pp.
- Willis, Y.L., D.L. Moyle and T.S. Baskett. 1956. Emergence, breeding, hibernation, movements, and transformation of the bullfrog, *Rana catesbeiana*, in Missouri. Copeia 1956:30-41



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United States Department of the Interior

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WASHINGTON, D.C. 20240



In Reply Refer To:
FWS/EHC/BFA

JAN 3 1990

Memorandum

To: Regional Directors, Regions 1, 2, 3, 4, 5, 6, 7 and 8

From: Deputy Director

Subject: Fish and Wildlife Service Mitigation Policy and Resource Category Determinations

The Fish and Wildlife Service (Service) issued its Mitigation Policy on January 23, 1981. Additional direction on use of the Mitigation Policy was provided by Director Dunkle in a memorandum of October 26, 1987. The October 26 guidance provided that 1) Resource Category determinations were to be supported by adequate technical rationale, 2) Resource Category 1 determinations would be reviewed by the Director prior to establishment of a final position by a Regional Director, and 3) the use of the term "Resource Category" was to be replaced with appropriate descriptive terms and supportive justification.

This memorandum is to affirm my support for the continued use of the Service's Mitigation Policy. This policy should be vigorously applied in determining mitigation needs and making mitigation recommendations. Further, the procedures as outlined in the guidance of October 26 remain in effect except that Resource Category 1 determinations need not be forwarded to me for approval, and numerical Resource Category determinations should always be accompanied by descriptive terminology and supporting justification.

I expect the Regional Directors to exercise appropriate quality control in seeing that the proper Resource Category determination is made and justified. Any questions on use of the Mitigation Policy should be forwarded to the Assistant Director for Fish and Wildlife Enhancement (ATTN: Endangered Species and Habitat Conservation (BFA)).